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Design of an Agent-Based Learning Environment for High-Risk Doorstep Scam Victims

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Abstract. Doorstep scams are scams, often happening at the front door, in which a con artist has a convincing, but fraudulent, story with the purpose of coming into your house and/or stealing money. Various campaigns to educate people exist, but they do not focus on the verbal skills people can use to prevent themselves from becoming a victim. This paper describes the conceptual design of a proposed training application. This application will provide an agent-based learning environment for high-risk doorstep scam victims. In order to create a training application, field research has been done to the content and progress of doorstep scams, which is used to create interactive scenarios.

Keywords: Virtual agent-based learning · Resilience training Interactive scenarios

1 Introduction

Doorstep scams are scams in which a con artist has a convincing, but fraudulent, story with the purpose of coming into your house and/or stealing money. Elderly people are at a high risk of becoming victims of such scams, often with a high emotional impact. Various campaigns and information websites (e.g. 'Scam awareness month'[1]) exist to warn and educate people on this phenomenon. In such campaigns, people are often educated on how to prevent doorstep scams from happening, or how to prevent intruders from coming in their houses, with behavioral tips such as opening the door with the chain on. However, besides behavioral actions in order to prevent a doorstep scam from happening, verbal skills (such as refusal assertiveness) are also important to be more resilient against doorstep scams. There is no large scale prevention campaign known that

[1] www.citizensadvice.org.uk/about-us/campaigns/current_campaigns/scams-awareness-month/.

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focuses on the conversation that takes place within a doorstep scam, and the verbal skills needed to prevent these scams from happening. On a smaller scale, actors are sometimes used to play a doorstep scam scenario with a group of people within larger meetings.

The Dutch ministry of Safety and Justice acknowledges doorstep scams as high impact crimes. They have funded this research in which, together with a large Dutch elderly organization called KBO-PCOB[2], a virtual training is under development. With this training, people learn how to interact (what to say and how to use their voice) with the use of virtual agents in a simulated world, in order to improve their resilience against doorstep scams. Within this research the main target group is elderly users, however the training could also be useful for other users. The advantages of a virtual training are that the training is available at any time and for a larger audience, that it can be used multiple times and it offers an opportunity to adjust to the user. Within other domains there has already been research towards using virtual agents for trainings that normally were performed using actors [3,4], which is considered to be less costly and more easy to control. Furthermore, previous research has shown that virtual trainings or serious games are effective learning resources [11,12,19,30].

This paper provides a conceptual design for a virtual training for verbal skills to improve the resilience against doorstep scams. First Sect. 2 provides an overview of related literature. Within Sect. 2.1 the domain of doorstep scams is further explained, followed by an overview of related interventions, both for the target group (Sect. 2.2) as well as for the learning purpose of this training (Sect. 2.3). Section 3 describes a conceptual design of the training proposed in this project. Finally, Sect. 4 summarizes the contribution of this paper and explains the future steps in the development of the training.

2 Doorstep Scams and Related Interventions

2.1 Doorstep Scams

Doorstep scams appear often appear at the doorstep, but also on the street or on the phone. The introduction stated that educational programs around doorstep scams often provide people with behavioral actions they can use to prevent doorstep scams. In contrast, the proposed training application focuses on the verbal skills that can prevent a doorstep scam from happening.

The content and progress of the stories told during doorstep scams have not been studied earlier. Therefore a field study has been done to better understand the content and progress of doorstep scams. For this field study the following sources have been used: a focus group meeting with the partner KBO-PCOB, various conversations with domain experts, (news) articles and reports.

[2] www.kbo-pcob.nl.

An overview of frequently encountered doorstep scam stories, based on the field study, is provided below:

- Stories at the door:
  - The electricity, gas, or water, needs to be checked by the con artist, therefore he/she must enter your home.
  - The con artist has a delivery (package, flowers) that he/she wants to give to the victim. Either this is an excuse to enter the house or it is an excuse to seduce the victim to do a small payment (e.g. delivery costs), often with the purpose to steal more money from the victim than just the payment.
  - A con artist in the role of handyman wants to do some job for the victim, however he/she asks (a large amount of) money that needs to be payed right away. The job will not be done (correctly), but the money is taken.
- Stories on the phone
  - The con artist calls with a story about fraudulent payments made, pretending to be the bank. He/she will ask private information, such as their debit/credit card PIN.
  - The con artist tells the victim that he/she has won a price, but in order to claim the price the victim needs to give information or make a small payment.
  - The con artist calls pretending to do a survey and asks the victim to give personal information. This information is later used to do a financial scam or identity theft.
- Stories on the street
  - The con artist claims to be collecting money or selling something for charity. Either the money is not used for charity or the con artist uses this to be able to easily pickpocket the target.
  - The con artist sells a newspaper or magazine, however the victim ends up with a long and expensive subscription.
  - The con artist sells some goods at the street, either the prize is too high (or the quality too low) or the good turns out to be completely worthless.

The fact that doorstep scams are a serious problem at the moment can be derived from the number of campaigns and news articles that can be found on the subject. However, it is hard to find statistics about the scope of the problem. This is due to the fact that there are multiple criminal activities associated with doorstep scams, which makes the registration inconclusive. Furthermore, often victims do not report a doorstep scam [15], for example due to shame.

2.2 Serious Games for Elderly Users

Various types of serious games targeting elderly users are used to address different difficulties the target group faces. An often used type of game is the exergame, a game in which the player has to perform some sort of physical activity. Mostly these games are used to address problems that have to do with physical activity of the elderly users and related problems. However, research has also been done

towards using exergames for seniors with subsyndromal depression [22]. Various exergames focus at balance and postural control. An often used technology for these sorts of exergames are the Nintendo Wii Fit, sometimes together with the additional Balance Board (e.g. [12,29]). Other technologies used are, for example, a step pad training [23], or Xbox Kinect games (such as [29]). Besides this, exergames are for example used to promote active aging [12].

Serious games for elderly users can be used to address problems with cognitive abilities. So called brain training games, such as Brain Age [19], improve the player's attention and memory skills. While these games are often designed especially to serve as a serious game, the research of Whitlock et al. [31] found that an existing game, World of Warcraft, improved the attention and spatial orientation of the players. Furthermore, Shang-Ti et al. [25] used an XBox 360 Kinect game to improve the selective attention of players.

Serious games for elderly do not only address physical or cognitive abilities, but it can also be used to enhance the users' social contacts, for example intergenerational interactions [5]. SilverGame [24] is a platform consisting of different activities to promote social activities. The activities also serve as entertainment and promote exercise.

2.3 Virtual Trainings for Social Skills and Resilience Against Scams

This research aims to improve verbal resilience against doorstep scams. This section gives an overview of other types of (computer-based) trainings that exist, within a broader scope of related trainings.

Phishing Training. Phishing is using social engineering techniques to obtain sensitive information[3], often performed via e-mail(s). Social engineering refers to using psychological manipulation to make people perform certain actions or disclose certain information[4]. Although this research is focused at doorstep scams, it is considered relevant to look at the domain of phishing, since social engineering techniques are also used in doorstep scams.

Educating people about phishing and online safety can be done in different ways, for example using cartoons [27]. Robila and Ragucci [21] tested user education consisting of quantitative testing and social context aware examples. The students that followed this education showed better phishing identification skills and gave a positive evaluation of the education they received.

Assertiveness Training. Being assertive means that you are behaving confident and that you dare to say what you think or believe[5]. This is a form of verbal resilience. Winship and Kelley [32] used a verbal response model to train assertiveness. Participants that were trained using this model showed an

[3] Definition based on: en.wikipedia.org/wiki/Phishing.
[4] Definition based on: en.wikipedia.org/wiki/Social_engineering_(security).
[5] Definition: dictionary.cambridge.org/dictionary/english/assertive.

increase in their assertive behavior. Another research showed that assertiveness training within a group can also be effective [20]. Furthermore, verbal modeling and therapist coaching can increase the refusal of unreasonable requests [14].

Saying No. Saying no, or refusal skills, are part of assertiveness trainings, applied in various domains among which are smoking behavior, drugs usage, shoplifting and rape prevention. There are various ways in which somebody can say no: you can simply say no, make aversive statements, give a reason for not accepting an offer, change the subject or walk away [18]. In order to learn students to resist direct and indirect pressures to engage in negative behaviors, an effective prevention program should both show different verbal strategies as well as the need to be assertive when refusing an offer [16]. Even though nonverbal assertive skills can be used for different types of situations, practicing verbal strategies with specific situations is also needed [18].

Verbal resilience also means that you use your voice in a assertive way. Nonverbal assertive skills that can be measured within the voice are for example: speaking firmly or authoritative [17], duration of a reply [1], medium latency of the response [1,7], the loud volume of the voice [1,7], and the medium fluency [7]. A way to measure assertiveness through behaviors is the Behavioral Assertiveness Test - Revised (BAT-R) [6], however the validation for this test is mixed [1]. One remark made is that for example the volume of voice is not unique for assertiveness.

Within this research saying no, although often implicitly, is an important aspect of the assertive behavior taught to the player. As suggested within the research of Nichols et al. [18] it is important to give verbal strategies for specific situations; this is done in the proposed virtual training.

Social Skill Training with Virtual Agents. Although some of the above-mentioned trainings are virtual, there are no examples mentioned yet of training programs for assertiveness with a virtual agent. Virtual agents are used for many different types of training programs, among which are social skills. For example the automated social skills trainer (ASST) [28], in which human-agent interaction takes place via user speech and language interaction. The proposed training focuses mostly on communication, previous research has been done in the same field, however no comparable virtual trainings are found. deLearyous [30] is a serious game used to train interpersonal communication skills. Players learn how to use Leary's Rose in their advantage. The communication with the agent is in this case performed by unconstrained written language input. Another serious game to train interpersonal communication skills is Communicate! [11]. This game is used to train communication in a consultation setting. The interaction with the agent in this game is via multiple choice.

3 Conceptual Design of the Training Application

The platform for which the virtual training will be developed is a tablet. Since this is an often used platform by elderly people, KBO-PCOB posed this requirement. The application consists of two components: the training scenarios and the game layer. The next subsections will discuss these components.

Besides choosing a suitable platform for the target group, it is also important to keep the target group in mind when designing the game. Tailoring a serious game to the elderly target group reduces the risks of factors, such as information overload, that reduce the efficiency of the game for this target group [12]. Not only the content and game play of the game must be tailored to the target group, also specific design principles [2] will be used to adjust the game design to the target group. This includes high contrasts and a larger font type.

3.1 Training Scenarios

The training scenarios consist of different components that together form an interactive training scenario with tailored feedback.

A **three-dimensional environment** will be created using the game engine Unity[6]. The environment will feature a small part of a residential area. Within this residential area there will be a decorated street, that can be used for the scenarios that take place on the street. Furthermore, one of the houses within the environment will be partly furnished to feature the scenarios taking place at the front door and phone scenarios that take place in the living room. Figure 1 shows the different view points within a prototype of the environment.

The **virtual agents** used within the scenarios, playing the role of doorstep scam artist, will be modeled using iClone[7]. With this software several agents will be created, which will be used in different scenarios. For each scenario at least two similar agents will be created, one female and one male. The outfits of the virtual agents need to suit the scenarios. In some scenarios this means that working uniforms have to be recreated using the same type of colors and adding

Fig. 1. Screenshots of the prototype environment with different virtual agents

[6] www.unity3d.com/.
[7] www.reallusion.com/iclone/.

a certain corporate logo. Figure 1 shows two prototype agents in the prototype environment.

In order to create credible facial expressions during talking, Facial Motion Capture[8] software, with a plug-in for iClone, will be used to map human actors' expressions to the virtual agents' faces. Furthermore, the actors' voice will be recorded, which will be used as the speech of the virtual agents.

The **interactive conversations** are interactive scripts of a doorstep scam, represented in a conversation tree. Within these conversation trees, vertices represent either atomic agent behaviours or decision nodes (which enable the user to select a response), whereas edges represent transitions between nodes. They are turn-based, always starting and ending with the virtual agent. Each round the player is offered three choices as response to the agent. In general these choices are of a good, moderate and bad level, influencing the conversation in the same way. Good in this context means assertive, bad means submissive. In general the outcomes of a conversation have the same mapping: good means no scam happened, and bad means that a scam happened.

Based on the information obtained during the field study a general outline is made for all the scenarios:

1. Background: getting to know the background of the story the con artist is telling.
2. Identity: getting to know about the identity of the con artist and his/her relation to the story that has been told.
3. Alternative: finding out alternatives to the suggested behavior by the con artist.

In each scenario these three aspects can be found in this order. It depends on the specific scenario how these aspects are addressed. Following the same outline in each scenario gives the players guidance for other (real life) doorstep scams.

For the prototype of the application six different scenarios (see Table 1) are written, based on the most heard about stories told during doorstep scams (see Sect. 2.1). To ensure that the scenarios are credible, they have been evaluated with various domain experts provided by the KBO-PCOB.

Table 1. Overview of the scenarios

	Location	Short description	Goal con artist
1	Front door	Energy meter check	Enter the house
2	Front door	Package delivery	Enter the house with package
3	Phone	Fraudulent bank activity	Gain personal bank information
4	Phone	Lottery won	Gain personal information
5	Street	Money for charity	Collect money for non-existing charity
6	Street	Sell bracelet for charity	Sell overpriced/fake bracelets

[8] www.facewaretech.com.

As stated in Sect. 2.1, people often do not report a doorstep scam. To motivate them to do so they are offered an opportunity to make a report in the application at the end of the scenario, they will receive feedback on this decision.

As stated in Sect. 2.3 being assertive is not only represented in the content of your message, but also in the way the message is communicated. The application addresses both: the content is represented in the different choices provided by the interactive conversation, the **speech analysis** module addresses the influence of how the message is communicated. The technique used for this module is based on the research of Formolo and Bosse [8], the technical details of the module are beyond the scope of this paper.

The speech analysis will be a separate module which is only available when the tablet is online, and it can be turned off and on by the player. When this module is turned on the player will not only be asked to make a choice within the scenario, the player is also asked to say this choice aloud and record this (within the application). The progress of the interactive scenario is then no longer only determined by the choices made, but also by the level of assertiveness measured in the voice of the player. When the speech analysis module is not used, each reaction of the player directly leads to a reaction of the virtual agent. However, when the module is turned on in some cases one choice of the player can lead to two different reactions by the agent, determined by the level of assertiveness.

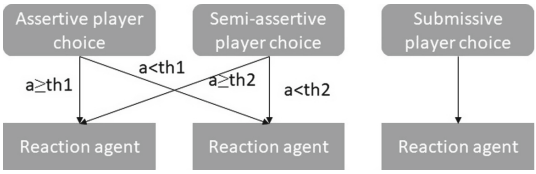

Fig. 2. Flow scenario taking speech analysis into account

Figure 2 shows the flow when speech analysis is taken into account. When no speech analysis is performed the flow chart does not have thresholds and diagonal lines. A high assertiveness score (a) means a very assertive reaction. When a player has a high assertiveness score this will lead to the reaction normally given to a assertive player choice, although this might not be the most assertive choice when looking at the content. This also works the other way around. Threshold1 (th1) is lower than threshold2 (th2), since a very assertive player choice needs a little bit less assertive voice to have an assertive impact on the virtual agent.

After each training scenario the player will receive feedback. This feedback consists of a general reaction on the outcome achieved (whether or not you became a victim of a doorstep scam) and some general tips for the specific scenario. Besides this there is also **tailored feedback**. As mentioned in the section about the Interactive Conversations, each scenario follows a general outline. For each scenario variables are defined within the three steps in the scenario, for

example asking the identification of the virtual agent. These variables are linked to a specific moment in the conversation. The feedback is tailored to the variables that are not reached within the conversation that has been held. So for example when the player did not ask the identification of the virtual agent, the player will receive feedback afterwards on asking identification during conversations.

The tone of the feedback is positive. The goal of the feedback is to inform and educate players, not to punish them for wrong behavior. This positive tone can be found in the general formulation of the sentences as well as in the fact that the feedback suggests other types of behavior instead of telling the player what not to do. Since the general outline of the different scenarios is comparable, players can use the feedback for different scenarios. Furthermore, since the scenarios are comparable to real world doorstep scams, the feedback is also reusable in different possible real world doorstep scams.

3.2 Game Layer

Goh et al. [9] give an overview of several strengths of serious games. One of these strengths is the fact that serious games offer covert learning, in combination with an already existing positive attitude towards games this makes serious games an easier accepted platform for learning. Furthermore, serious games are seen as fun and motivational since players want to achieve goals within the game. Another important strength of serious games is the feeling of control players have; they can practice a scenario as many times as they want to master a skill and they always have the option to shut down the tablet, giving them a feeling of safety.

Greitzer [10] defines four levels of engagement for computer-based trainings (see Fig. 3). The proposed training aims at level three engagement, in which a limited amount of branching within the interactive scenario follows the choices of the player.

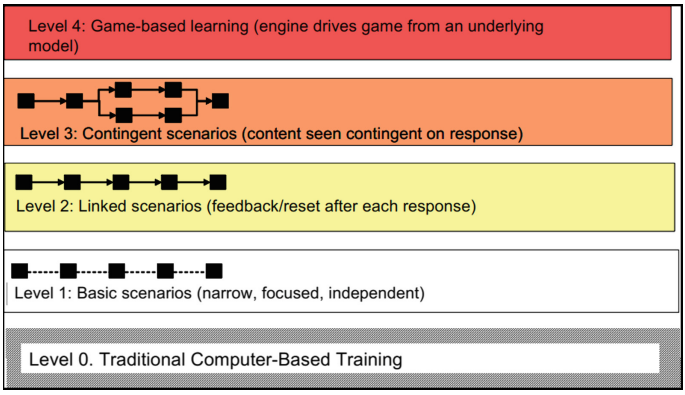

Fig. 3. Levels of engagement for computer-based trainings [10]

Siang and Radha Krishna [26] created, based on the hierarchy of needs from Maslow [13], a hierarchy of players' needs (see Fig. 4). This hierarchy can help game designers to guide the motivation of players. The game layer of the application will be built around the actual training scenarios with the purpose of motivating players to (repeatedly) do the training. The players' needs of Siang and Radha Krishna [26] are addressed in the following way:

- Rules need: The players will receive an explanation about the rules of the game at the beginning, as well as instructions while they are playing.
- Safety need: The player will receive feedback at the end of each training scenario. The positive tone of the feedback will give them the feeling that they can handle the scenarios. Furthermore, when the player falls for a doorstep scam within the training this will not affect the player in real life.
- Belongingness need: The feedback that the players receive after each scenario helps them to improve their resilience against doorstep scams as they can use the feedback for other scenarios as well.
- Esteem need: The players have control over the scenarios since they can make choices influencing the progress of the scenario, as well as the option to quit a scenario. Furthermore, by the feedback received from the game, the players will be encouraged, boosting their esteem.
- Need to know and understand: By repeatedly training different scenarios players will improve their resilience skills, which gives them the ability to train with even more advanced scenarios that can be unlocked at a certain skill level.
- Aesthetic need: Several state of the art game development techniques have been used to build a 3D-environment with credible virtual agents.
- Self actualisation need: (Advanced) players can play scenarios multiple times to test the reaction the virtual agent gives on different reactions, allowing them to test different reaction strategies.

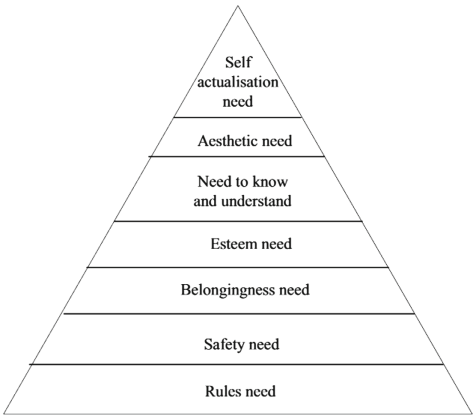

Fig. 4. Hierarchy of players' needs [26]

4 Conclusion and Future Work

Within this paper the content of doorstep scams was investigated in order to create a virtual agent-based learning environment for high-risk potential victims of doorstep scams. With a field study the general structure and content of doorstep scams was explored, which was used to create various interactive scenarios. These interactive scenarios will be used within a virtual training application. The aim of this virtual training application is to improve the verbal skills of the users, in order to empower their verbal resilience against doorstep scams. No other large scale interventions are known that serve the same purpose. The application that is currently being developed can be used in an individual setting, but it can also be used as a tool for group interventions.

The conceptual design and the scenarios are used to create a prototype of the application. Besides developing the application the speech analysis must also be trained specifically for identifying assertive and submissive voices. Furthermore various evaluation meetings will be arranged to improve the prototype. Once a prototype of the application is working, it will be evaluated with a small focus group of possible users (elderly people).

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